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Project Summary

Mercury in Petroleum and Natural Gas: Estimation of Emissions from Production, Processing, and Combustion

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The report is intended to assist in the identification of those areas that require additional research, especially the needs associated with measuring the concentrations of the various chemical species of mercury (Hg) in the various feedstocks and waste streams associated with the oil and gas industry. Acquisition of additional information will be necessary if the magnitudes of Hg emissions associated with U.S. petroleum and natural gas are to be estimated accurately.

This Project Summary was developed by the National Risk Management Research Laboratory's Air Pollution Prevention and Control Division, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Discussion

Mercury (Hg) extracted from the earth in oil and gas, including that in associated waste streams, contributes to the global Hg cycle. While the amount of Hg that derives from burning coal can now be estimated with reasonable confidence, the amount that derives from petroleum cannot be estimated with equal confidence at present. The report provides a compilation of currently available data on the concentration of Hg in oil and gas and in the various waste streams associated with petroleum and gas production, transportation, and processing. From these data, estimates are compiled of the contribution of Hg to the U.S. (and global) environment. The estimates are incomplete due to lack of data, but they do provide a framework from which one can gain a rough, but preliminary, idea of the amounts that may be involved. With additional data inputs to the estimates, it eventually may be possible to estimate the total amounts of Hg emissions from oil and gas with greater accuracy. Table 1 summarizes the estimates compiled and discussed in the report.

The report and cited references generally use a material balance approach to estimating Hg emissions to air, water, and solid waste streams. A material balance can be applied to oil and gas production by examination of Hg in produced fluids including discharged water and drilling waste. Note that not all of the Hg in waste streams originates with the Hg in the reservoir. In production, some of the Hg originates from cuttings (rock not necessarily associated with the reservoir) and from the chemicals (barite) used to add weight to the drilling fluids. When a material balance is applied to a refinery, a small portion of the Hg originates with treatment chemicals, but the majority comes from the oil that is processed.

Currently available data for total Hg (dissolved and suspended) in petroleum and fuel products, when applied to a mass balance for Hg in the U.S. refining system, provide an order of magnitude estimate of the contribution of Hg in oil and gas to U.S. anthropogenic emissions. The model finds the mean amount of Hg in petroleum refined in the U.S. to be close to 10 ppb and predicts that the amount of Hg in fuel products burned in

Table 1. Summary of Estimates for Hg Emissions from Oil and Gas Production and Processing

Type	Industry Segment	Category	Amount of Discharge (10^6kg/y)	Total Hg (ppb)	Estimated Emission Rate (kg/y)
Water	Oil and Gas Production	Produced Water	500	1?[a]	500
	Oil Refining	Refinery Water	250	1?	250
	Oil Transportation	Tanker Ballast	?	1?	?
Subtotal					**750**
Solid Waste	Oil and Gas Exploration	Drilling Waste	50	100?	5,000
	Oil Refining	Refinery Waste	30	50?	1,200
Subtotal					**6,200**
Air	Oil Production	Flared Gas	4.5	1.5?	10
	Oil Production	Fugitive	1	185	185
	Gas Production and Transmission	Fugitive	5.9	?	?
	Oil	Fuel Combustion	790	<8	6,000
	Gas	Fuel Combustion	341	<0.3?	100
Subtotal					**6,300**
TOTAL					13,250

the U.S. is less than approximately 6,000 kg/y. The amount of Hg in U.S. fuel oil was estimated to be no greater than approximately 1,500 kg/y. This number is somewhat in conflict with current U.S. EPA estimates of Hg in fuel oil (10,000 kg/y).

While the estimates compiled in this report are useful in the present time frame, they are insufficient to answer some major issues and questions that are important in determining the contribution of Hg in petroleum to global pools and fluxes. For example, data on refined products are scarce and undocumented as to the refineries from which they originate. Thus it remains uncertain as to whether the Hg in crude oil is accounted for mainly by the amount in products (> 50%) or if it distributes more prevalently to other avenues of egress from refineries (solid waste, wastewater, fugitive emissions).

It does appear that, based on currently available data, approximately half of the entire amount of Hg associated with oil and gas (exploration, production, transportation, processing) enters the atmosphere in fuel combustion. Some unknown portion of this amount is captured by pollution control equipment, but the total is likely to be less than approximately 6 Mg/y (if the mean amount of Hg in crude oil is 10 ppb as expected). This would suggest that, while oil and gas account for approximately the same mass of fossil fuel burned yearly in the U.S., the amount of Hg in combusted petroleum and gas is about 10 times less than that which derives from coal (66 Mg/y).

The distribution of Hg to effluents and air emissions in the refining process is important, and only limited data are available upon which any definite conclusions can be drawn. Insufficient data are available for many of the major refinery streams including wastewater, solid waste, still gas, treatment fluids, and products. To obtain a firm understanding of the fate of Hg in refineries, it would be necessary to examine the individual unit processes (desalting, distillations, hydrotreating, and catalytic cracking). In each case, the attempt to determine the distribution of Hg would require tracking not only total Hg but also its various species (volatile, oxidized, inert) by measuring concentrations of each species in all of the streams that enter and exit the process.

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The complete report, entitled "Mercury in Petroleum and Natural Gas: Estimation of Emissions from Production, Processing, and Combustion," (Order No. PB2001-109026; Cost: $29.50, subject to change) will be available from:
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5285 Port Royal Road
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(800) 553-6847 (U.S. only)
The EPA Project Officer can be contacted at:
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